**DOI**: https://doi.org/10.52756/ijerr.2025.v48.009 *Int. J. Exp. Res. Rev.*, Vol. 48: 103-111 (2025)

*Original Article* | *Peer Reviewed* | *Open Access*

International Journal of Experimental Research and Review (IJERR)
© Copyright by International Academic Publishing House (IAPH)
ISSN: 2455-4855 (Online)
www.iaph.in
ISSN 2455-4855

# Development and Characterization of Brass-Graphite (Sn) Composites for Bush and Bearing Applications

**Yogesh Sathe and Pawan Somavanshi***

Mechanical Engineering, Government Engineering College Aurangabad, Chhatrapati Sambhajinagar, Maharashtra, India- 431005

**E-mail/Orcid Id:**

*YS,* workshop@geca.ac.in, https://orcid.org/0009-0009-0023-8215; *PS,* pawansomavanshi.phd@geca.ac.in, https://orcid.org/0009-0003-3755-4058

**Article History**:

**Received:** 04th Feb., 2025
**Accepted:** 24th Aug., 2025
**Published:** 30th Aug., 2025

**Keywords:**
Brass Composites, Tin, Graphite, Stir Casting, UTS, Impact Strength, Hardness, EDS, SEM

**How to cite this Article:**
Yogesh Sathe and Pawan Somavanshi (2025). Development and Characterization of Brass-Graphite (Sn) Composites for Bush and Bearing Applications. *International Journal of Experimental Research and Review*, *48*, 103-111.
**DOI**: https://doi.org/10.52756/ijerr.2025.v48.009

**Abstract:** This research focuses on the characterization of the mechanical and microstructural properties of stir-cast brass-based composite containing 12% Tin (Sn) and 2%, 4%, 6%, 8%, and 10% Graphite (Gr) as reinforcement. The goal was to establish the impact of Graphite on the properties of ultimate tensile strength (UTS), impact strength, hardness, and microstructure of composites to find out the ideal reinforcement percentage. The characterization of the improved brass composite showed that the best overall result was achieved when 6% Graphite was added, indicating a 14% improvement in UTS, a 31.4% increase in impact strength, and an 11.8% increase in hardness compared to the brass. SEM microstructure test supported by the result of reinforcement localization of Graphite at 6% and EDS test supported the presence of reinforcements in the matrix. Their properties decreased when the graphite content exceeded 6%, due to clustering and porosity. As a result, this study reveals that the use of brass-graphite composites, with 6% Graphite as the best option for self-lubricating bush and bearings, where issues related to strength, hardness, and wear are highly valued.

## Introduction

Over the past few years, there has been a heightened interest in generating materials with enhanced mechanical and tribological qualities for lightweight, durable, and high-performance applications across industries, including aerospace, automotive, and marine engineering. The concept appeared to be attractive due to the possibilities to achieve the desired characteristics of the MMCs based on the properties of the matrix and reinforcing particles, as well as improved strength, toughness, and wear resistance (Nithesh et al., 2017). Brass is an industry work-horse because it is an alloy containing copper and zinc and has remarkable qualities like high corrosion resistance, good thermal conductivity and ease of machining. However, its relatively low tensile strength and wear resistance put the brake on the use in high-performance conditions (Sreenivasa et al., 2024). To overcome this challenge, the fabrication of brass with secondary materials like Tin (Sn) and graphite has been considered to improve its mechanical and microstructural properties. Tin is effective in increasing the tensile strength and reducing the corrosion of metal alloys, whereas graphite, a solid lubricant, increases the wear of metal alloys by reducing friction (Sundararajan and Mani, 2024). The prospect of brass-based composites containing both Tin Graphite reinforcements will therefore create composites with a proper combination of mechanical and tribological properties. These reinforcements, when distributed and placed in the right manner in the brass matrix, will yield the right properties needed for the application (Somavanshi and Sathe, 2024).

Stir casting is adopted for the production of MMCs owing to its efficiency and low cost, and has advantages in terms of distributing reinforcements uniformly within the metal matrix. Here, the base metal is melted, and reinforcements are added through high stirring before the

*Corresponding Author: pawansomavanshi.phd@geca.ac.in



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

entire material is poured into moulds (Clinktana et al., 2019). Impotence stimulation speed, temperature, as well as reinforcement content, are important factors that act as control on the properties of the final composite. Although extensive work has been reported in MMCs, there is scant information regarding the synergistic impact of Tin and varying percentages of Graphite on the mechanical and microstructural characteristics of brass-based composites. This study seeks to address this issue by systematically reviewing the effects of 12% constant Tin and varying Graphite content of 2%, 4%, 6%, 8% and 10% on the ultimate tensile strength (UTS), impact strength, and hardness of stir-cast brass-based composites (Deaquino-Lara et al., 2014). In addition, the elemental distribution in the synthesised composites is determined using Energy Dispersive Spectroscopy (EDS) and microstructural properties of the samples are investigated by Scanning Electron Microscopy (SEM). These findings from the research study are expected to provide significant insights into the ongoing development of brass-based composite materials, utilizing tin and graphite reinforcements specifically designed for enhanced engineering applications (Somwanshi and Rathi, 2018; Jeon et al., 2013).

## Materials and Methods

### Materials Selection

#### Base Material

**Brass**

Brass has been chosen as the matrix material of the composite because of its high corrosion resistance, thermal conductivity and ease of machining (Parikh et al., 2023). Due to these properties, brass finds various great uses in most engineering-related activities. However, because of its relatively low strength and wear resistance, the alloy needs reinforcements in order to enhance its mechanical properties (Alam et al., 2021). The particular grade of brass used in this case was determined by its compatibility with the chosen reinforcements as well as its suitability for stir casting without deleterious effects on properties (Kumar et al., 2020).

**Figure 1. Brass Material.**

#### Reinforcement

#### Tin powder

Tin powder is utilized in optoelectronics, electronics, specialty alloys, data storage technologies, and catalysts due to its high electrical conductivity, low electrochemical migration, ease of soldering, and low cost. Tin, a chemical element with the symbol Sn and an atomic number of fifty, is mainly sourced from cassiterite ($SnO_2$). This is a soft, easily shaped, fairly pliable, and noncorrosive metal with a relative density of about 7.0 and a melting point of about 232°C (Zhang et al., 2024). Tin has two main allotropes: the stable β-tin at room conditions and α-tin, which crystallizes at a diamond-like cubic lattice at low temperature. As a catalytic, chemical, electrical, and antibacterial/antifungal agent, tin has numerous applications in various industries, particularly the metallurgical industry.

**Figure 2. Tin powder.**

#### Graphite

Graphite (C) micron powder is a very fine black powder consisting of pure carbon with more than 99.9% purity and particle size of 1–5µm, commonly used in metal matrix composites (MMCs). Its high thermal conductivity, its good lubrication, and low mass contribute to increased wear resistance, low friction, and heat dissipation, making it suitable for aerospace, automotive and industrial applications (Dusoe et al., 2017). Graphite possesses such valuable features as self-lubrication, high thermal stability, low coefficient of thermal expansion, and chemical inertness, and an enriched hexagonal structure of carbon atoms (Jamwal et al., 2020). The requisite specific gravity is 0.2 to 0.3$cm^3/g$, the ash content shall not exceed 0.1% and a layer of 6 to 10 atomic layers has been deemed necessary for enhancing mechanical and lubricant qualities in the MMCs by acting as an additive (Kumar et al., 2024).

**Figure 3. Graphite powder.**

DOI: https://doi.org/10.52756/ijerr.2025.v48.009

## Fabrication of Composite Sample

The composite sample was prepared by the stir casting technique from RBI Metals, Chikalthana MIDC, Aurangabad.

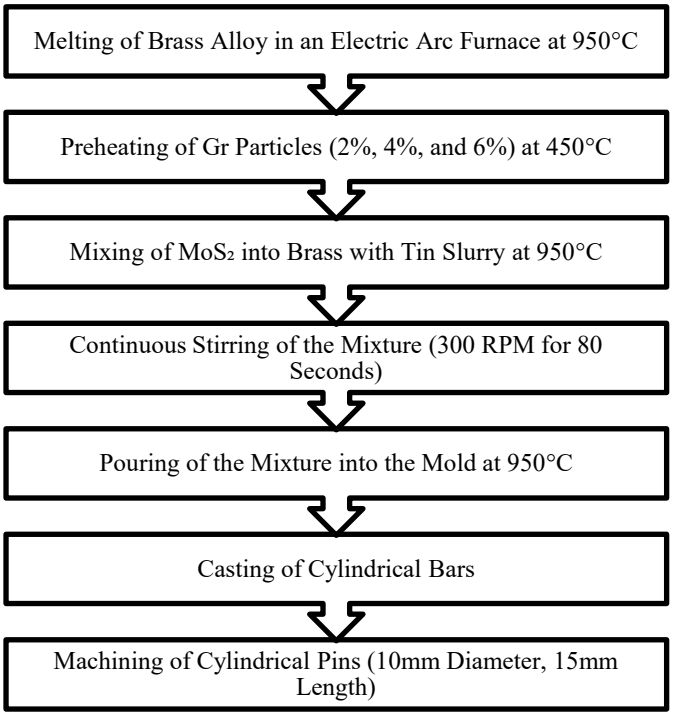

Melting of Brass Alloy in an Electric Arc Furnace at 950°C
Preheating of Gr Particles (2%, 4%, and 6%) at 450°C
Mixing of $MoS_2$ into Brass with Tin Slurry at 950°C
Continuous Stirring of the Mixture (300 RPM for 80 Seconds)
Pouring of the Mixture into the Mold at 950°C
Casting of Cylindrical Bars
Machining of Cylindrical Pins (10mm Diameter, 15mm Length)

**Figure 4. Flow chart of casting.**

### Fabrication Process

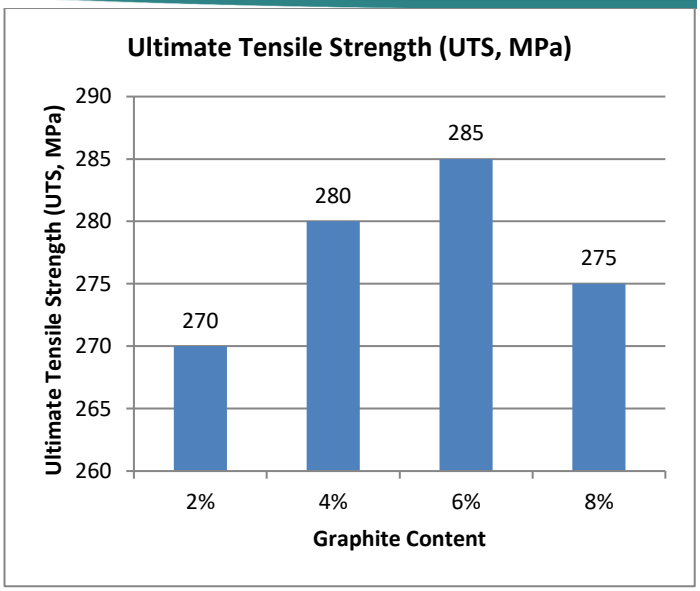
The composites were synthesized using the stir casting method. The steps involved were (Singh et al., 2018):

1) Melting: A Graphite crucible in which brass was melted was made using an induction furnace at 1000°C.
2) Reinforcement Addition: Tin and Graphite powders were pre-sintered and slowly mixed into the molten brass, which was stirring at 500rpm for 10minutes to ensure the powder distribution is even.
3) Casting: The molten gated composite material was then poured into a hot metal mould and allowed to cool.
4) Post-Processing: The cast samples were machined to the standard sample size for mechanical and microstructural properties determination.

## Experimental Analysis of Mechanical Properties

### Mechanical Properties

The tensile properties of the brass-based composites were determined through tests conducted at S.N. Metallurgy, Waluj MIDC, Aurangabad, using a Universal Tensile Machine (UTM) based on ASTM E8 (Zeng et al., 2009).




**Graph 1. Variation of Ultimate Tensile Strength with Graphite Content in Brass-Based Composites.**

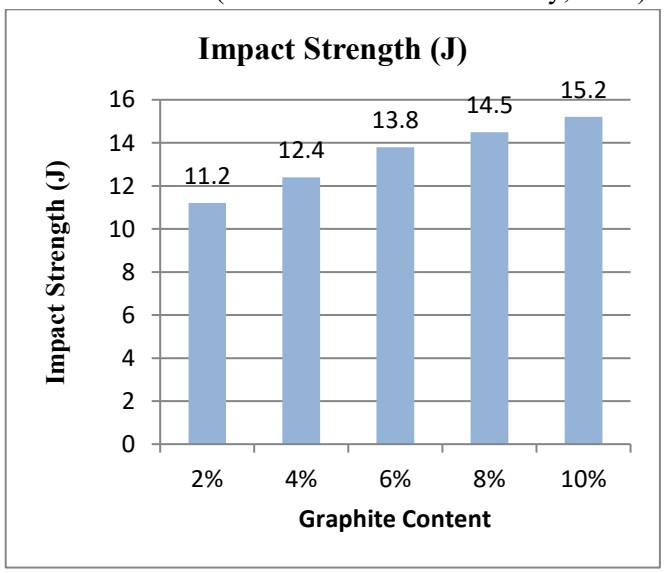
The ultimate tensile strength (UTS) of the following developmental brass composites, reinforced with Constant Tin (12%) and varying graphite percentages (0%, 2%, 4%, 6%, 8% & 10%), differs due to the mechanical reinforcement and lubricating properties of Graphite. At 0% Graphite, the basic brass alloy exhibits a UTS of approximately 250 MPa, which would represent the normal unreinforced brass. As a result of optimized loading and minimal defects in the graphite ratio of 2%, the UTS increases to 270MPa, and the stress is distributed evenly throughout the graphite. When 4 % of Graphite is incorporated, the UTS is even higher at 280 MPa. This improvement has been attributed to the better distribution of reinforcements, which enhances the compositeness of the material by limiting dislocation mobility. The highest value of UTS, reaching 285 MPa, is achieved with 6 wt% Graphite content when the interfacial adhesion between the matrix and reinforcements is strongest. This condition serves the purpose of increasing mechanical properties while maintaining minimal clustering and weakening effects (Nazeer et al., 2020). In Beyond 6% Graphite though, there is a downward trend which is evidenced by the UTS. The UTS at 8 % Graphite is 275 MPa, and with further addition of Graphite, there is a perception that the Graphite starts to perform as a solid lubricant. This lubricating impact reduces load transfer efficiency at the matrix-reinforcement interface to reduce bond strength between the reinforcement and the matrix. For 10% Graphite the strain value decreases to 260MPa an indication of the consequences of weakened interface and clustered coalesced Graphite particles present in the composite. These clusters form stress concentrations and diminution of the general composite integrity. The

DOI: https://doi.org/10.52756/ijerr.2025.v48.009

observed trend raises the importance of managing the content of Graphite in a way that maximises the benefits that reinforcing materials could bring while minimising the aforementioned risks. The composite structure and bonding are most favorable at 6% Graphite and hence, the mechanical performance is also highest at this concentration (Yang et al., 2023).

## Impact Strength

To study the impact toughness of the developed composites, an impact test using the Charpy impact tester instrument was conducted as per the ASTM standards E23. Specimens in notch bar form, to test size, were harvested and exposed to a pendulum impact force. Impact strength was determined as the energy that was imparted to the specimen before it fractured. This test assesses the energy absorption capability of material under conditions of an impulse load, and in this regard is a critical parameter for cases where dynamic or shock loads are involved (Manubolu and Vanimireddy, 2023).

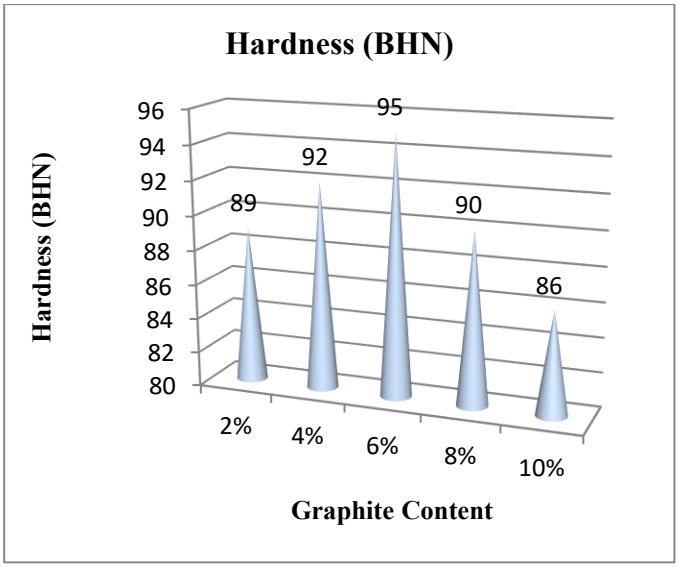



**Graph 2. Variation of Impact Strength with Graphite Content in Brass-Based Composites.**

The results on the impact strength and Vickers hardness of the brass composites containing 12 wt.% of Tin and several volume percent of Graphite (0, 2, 4, 6, 8, and 10) demonstrate absolutely opposite tendencies, which point to the ability of Graphite to adjust the combined characteristics of material's toughness and its hardness. These test results showed that the impact strength increases with a rise in Graphite content since it has good energy-absorbing capability at times of deformation. The base brass alloy has an impact strength of 10.5J, which increases to 11.2J and 12.4J upon adding 2% and 4% Graphite in the brass alloy. This enhancement is due to the constraint of crack propagation and improved load transfer. At 6 % of Graphite, the impact strength is 13.8 J due to the best loading reinforcement ratio. The maximum IIS of 15.2 J is obtained on 10% Graphite where Graphite has enhanced the toughness of the composite and the electronic precursor does not have the capacity to force the composite to brittle failure (Somavanshi and Sathe, 2023).

## Brinell hardness test

The Brinell Hardness test is conducted in S.N. Metallurgy Pvt. Ltd., Aurangabad. This has been presented in the following graph. The white color bars represent the hardness of different composites measured in Brinell hardness number using the test method ASTM E10. The test included applying a stainless steel or tungsten carbide hard ball on the surface of the specimen with a standard force for a particular period. The final dimension of the indentation left on the surface was measured using a micrometre and then the BHN was calculated. Hardness is the ability of a material to resist permanent deformation in a localized zone, providing a measure of its wear resistance and durability (Yu et al., 2021).




**Graph 3. Variation of Hardness with Graphite Content in Brass-Based Composites.**

It increases up to 6 % of Graphite and decreases with further addition of Graphite. The base brass alloy has a Hardness of 85 BHN, while 2% Graphite containing alloy exhibits a hardness of 89 BHN and the 4% Graphite containing alloy has a hardness of 92 BHN because of grain refinement and strengthened matrix. This rises to a maximum of 6 percent at which the hardness reaches 95 BHN due to the best dispersion of the reinforcements and good interfacial adhesion. Nonetheless, at 8% and 10% Graphite, hardness decreases to 90 BHN and 86 BHN, respectively, as the fluidity of excess Graphite reduces the matrix's ability to resist deformation. These trends explain how Graphite made the composite to have high impact strength but with low hardness. There is an

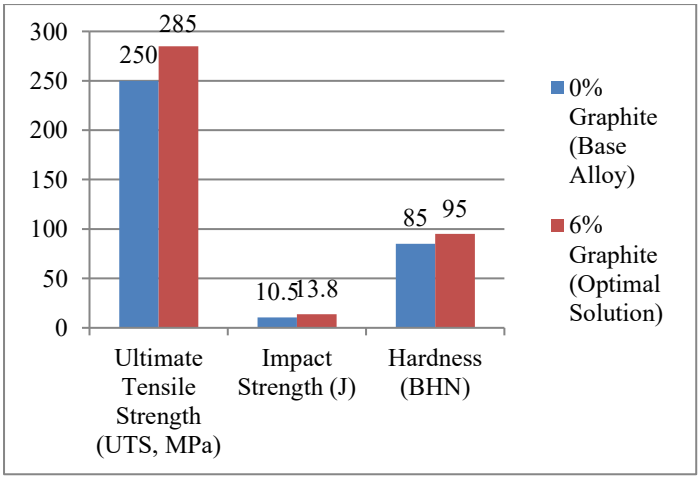
DOI: https://doi.org/10.52756/ijerr.2025.v48.009

optimal level of reinforcement at 6% Graphite, which combines high toughness and also hardness for engineering applications (Zeng et al., 2009).

### Comparison of Mechanical Properties

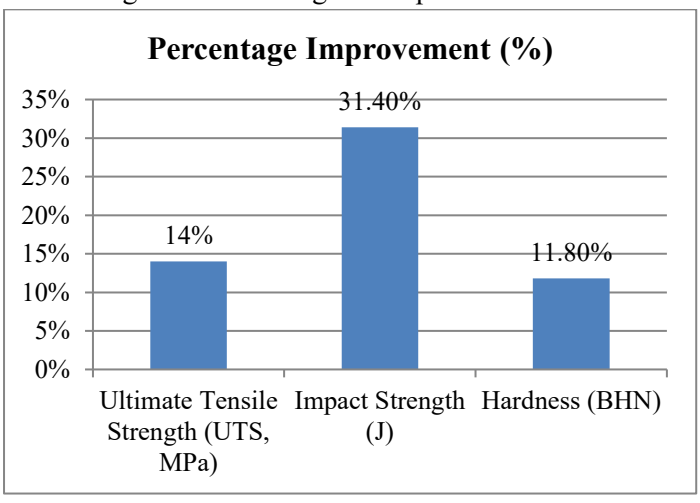
### Pure Brass vs. Composite Reinforced Brass

From table 1, comparing the mechanical properties (Ultimate Tensile Strength, Impact Strength, and Hardness) of the brass-based composite with 0% Graphite content (base alloy) versus 6% Graphite content (optimal solution):




**Graph 4. Pure Brass vs. Composite Reinforced Brass.**

- Ultimate Tensile Strength (UTS): It is shown that the composite with 6% Graphite tension strength is 14% higher than the base alloy, owing to higher interfacial bonding and better load transfer due to optimum dispersion of Graphite.
- Impact Strength: At 6% of Graphite content, a significant improvement of 31.4% in impact strength is measured. The energy-absorbing properties of Graphite particles uniformly distributed lead to increased toughness.
- Hardness: Results show an increase in hardness of 11.8 % at 6 % Graphite, with the brass matrix strengthened by well-dispersed Graphite reinforcements, minimizing softening effects with higher Graphite content.




**Graph 5. Percentage Improvement.**

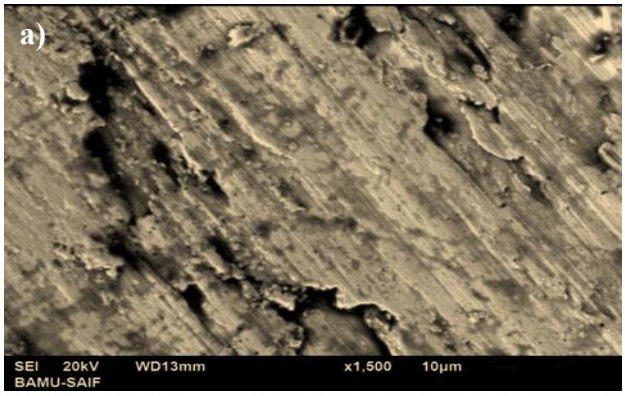
## 4. Microstructural and Elemental Analysis

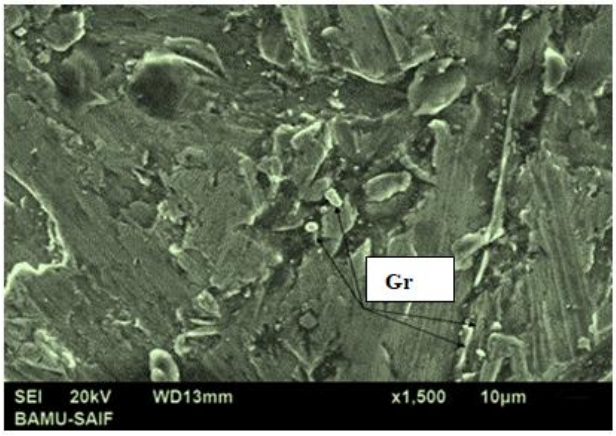
### 4.1 Scanning Electron Microscopy

It was done at the Central Facility Center, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. High-resolution imaging was performed using an Analytical Scanning Electron Microscope (SEM) JEOL JSM-6510A, while the analysis SEM was also a JEOL JSM-6510A.

**Figure 5. Scanning Electron Microscope.**

SEM and EDS were used to analyze the distribution and dispersion of graphite particulates in the brass-based composites. Wear mechanisms, defects, porosity, and the uniform integration of reinforcements were studied by examining SEM images of worn surfaces and confirmed by EDS for elemental composition.




DOI: https://doi.org/10.52756/ijerr.2025.v48.009

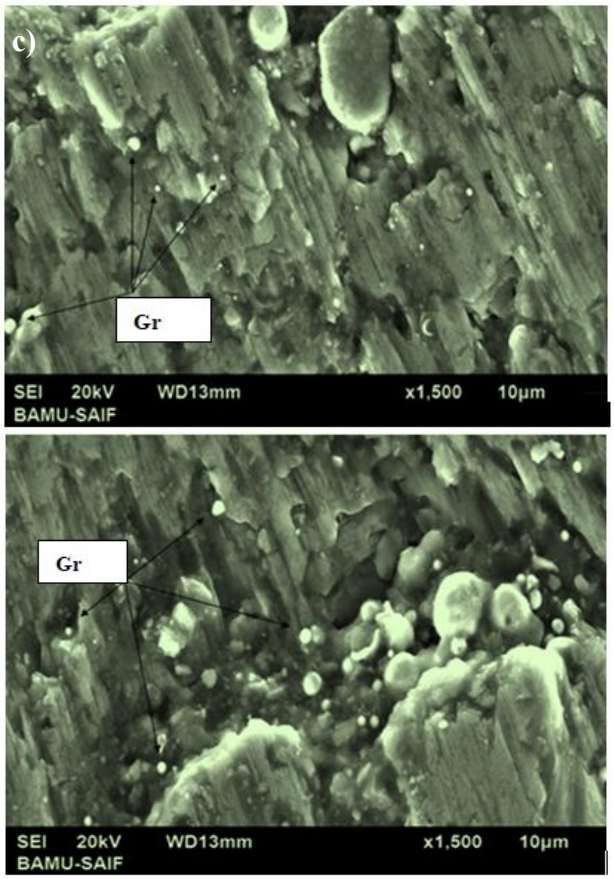



**Figure 6. SEM Micrographs Showing Morphology of Brass-Based Composites (a) Pure Brass Alloy, (b) Brass + 2% Graphite, (c) Brass + 4% Graphite, (d) Brass + 6% Graphite.**

(a) Pure Brass Alloy: The micrograph of pure brass has a good, smooth surface with few reinforcements, which indicates the uniform matrix structure. It provides good machinability and corrosion resistance, but mechanical and tribological performance are not enhanced by strength, toughness, and/or wear resistance, and it is, therefore, limited.

(b) Brass + 2% Graphite: Small graphite inclusions are embedded in the brass matrix, as shown in the composite with 2% Graphite. While the distribution is not fully optimized, these particles contribute to load transfer and crack resistance, making this the first stage in particle reinforcement incorporation.

(c) Brass + 4% Graphite: As compared with 4 % Graphite, the microstructure has a more uniform distribution of particles in the matrix. The Graphite achievement in well disperses also helps stress distribution improve mechanical properties, such as tensile strength and impact toughness.

(d) Brass + 6% Graphite: The composite displays optimal dispersion with no apparent porosity or clustering at 6% Graphite. Top peak values for tensile strength, impact toughness, and hardness are achieved through the high interfacial bonding between Graphite and the brass matrix, which provides the best compromise between reinforcement and matrix integrity.

## Energy Dispersive Spectroscopy (EDS)

It is a technique used to analyze the chemical composition of materials by detecting X-rays emitted when a sample is exposed to an electron beam (Manubolu and Vanimireddy, 2023).

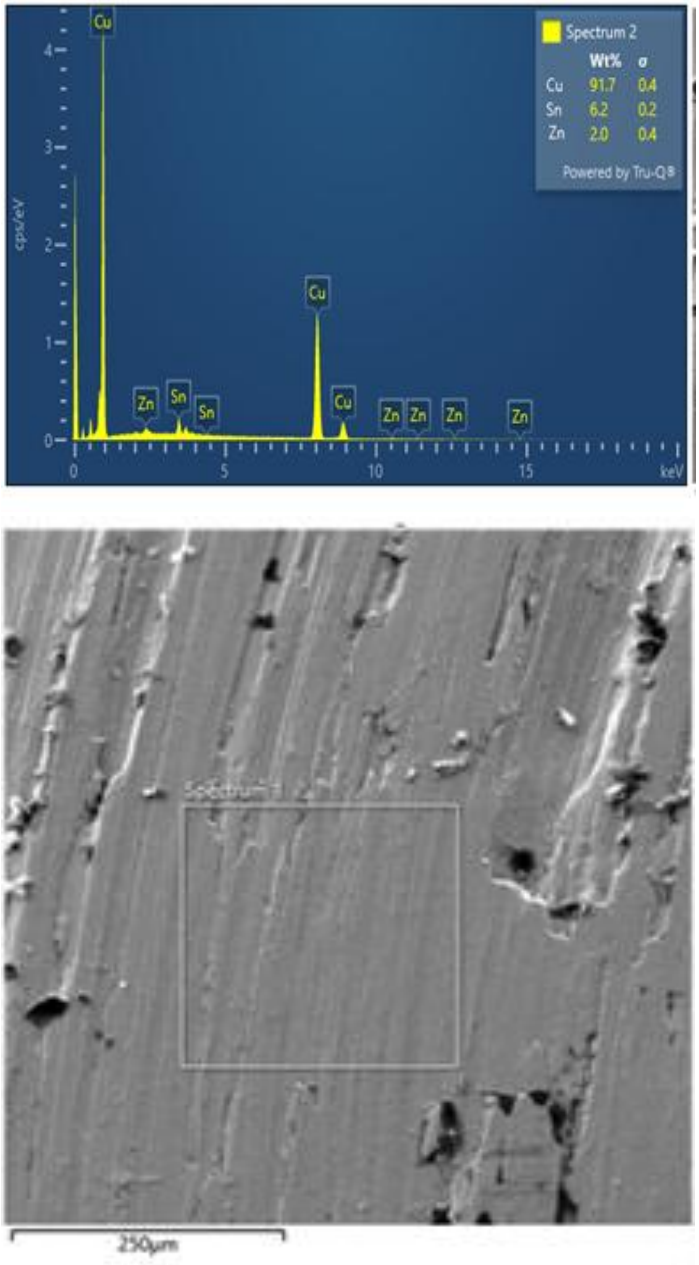



**Figure 7. EDS Analysis Brass-Based Composites.**

According to figure 6, the EDS spectrum of pure brass-based composite shows the main elements: Cu, Zn, and Sn. The dominant element is copper with a weight percentage of 91.7 and zinc is 6.2 percent, and tin is 2.0 percent. The expected makeup of the brass alloy is confirmed by this composition, with copper as the base material and zinc as the leading alloying element. Besides the lack of carbon or graphite, this sample shows the absence of reinforcements.

DOI: https://doi.org/10.52756/ijerr.2025.v48.009

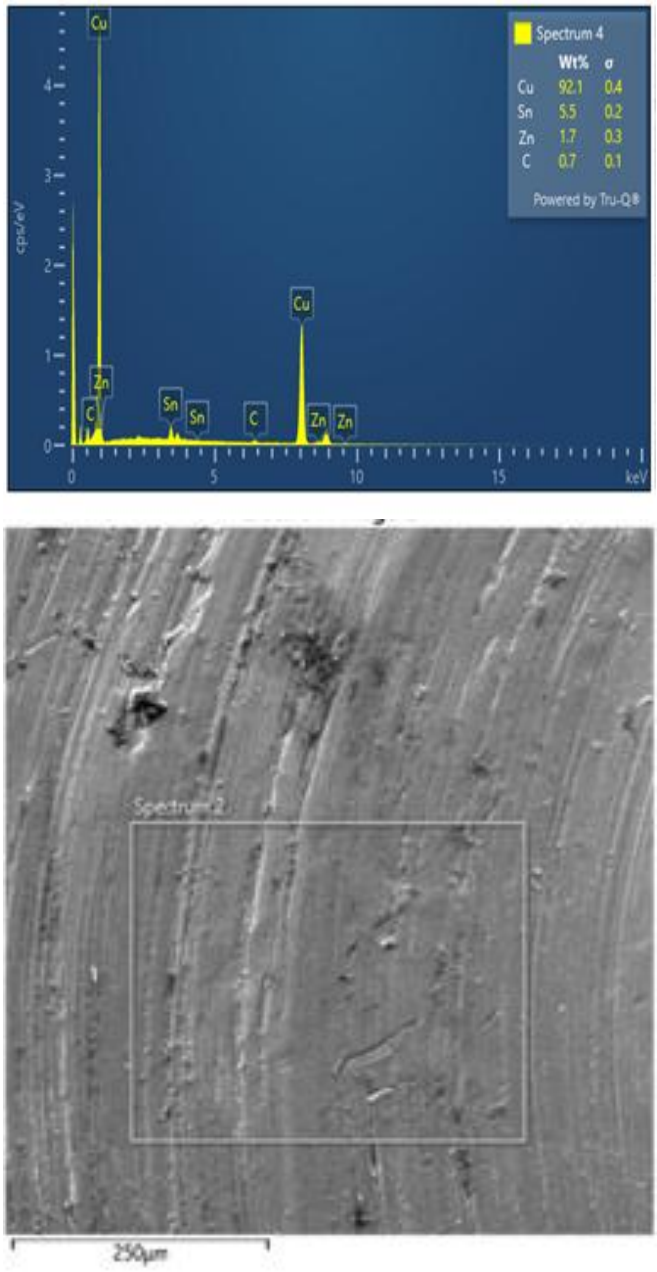



**Figure 8. EDS Analysis Brass-Based Composites with reinforcement (Graphite).**

The EDS spectrum of the brass-based composite, which is also reinforced with graphite from figure 7, confirms the graphite incorporation as a distinct carbon (C) peak is present. This sample contains a mass of 92.1 % copper, 1.7 % zinc, 5.5 % tin and 0.7 % carbon. The success of the brass matrix being reinforced with graphite is depicted by the presence of carbon. Moreover, the zinc content of the brass sample slowly decreases compared to the pure brass sample, presumably resulting from the presence of graphite, which in turn can affect the degree of composition. It is these EDS analyses of the pure brass alloy and the graphite-reinforced brass composite that illustrate the elemental variations yielded by graphite as a reinforcing material between the two materials.

## Conclusion

This research, therefore, aimed at comparing the mechanical and microstructural characteristics of a brass-based matrix that incorporated a fixed 12%Sn and varying percentages of Graphite 2%, 4%, 6%,8%, and 10% via the stir casting method. Based on the results, the following conclusions can be drawn:

### Optimal Mechanical Properties

- Ultimate Tensile Strength (UTS): The composite with 6% Graphite reinforcement was observed to possess a UTS of 793 MPa, which is an improvement of 14% compared to the base alloy. Beyond this level, the UTS declined due to the role of excess Graphite, which reduces the interfacial strength of the matrix with reinforcement.
- Impact Strength: This shows that it had gained an overall impact strength of 31.4% at 6% Graphite reinforcement as compared to the base alloy, disclosing the improvement in energy collapse nature of the composite. With even higher Graphite content, the increasing trend continued, up to the 10th percent, the point at which the composite has a reasonable degree of higher toughness.
- Hardness: The hardness of the composite improved by 11.8% at 6% Graphite content in contrast to brass due to grain refinement and an increase in the interfacial bonding. Subsequent increases in Graphite led to a decrease because of its lubricating property, which softened the matrix.

### Microstructural Analysis

- Scanning Electron Microscopy (SEM): SEM analysis showed that Graphite particles were well distributed in the matrix along with 6% reinforcement providing best mechanical properties. In addition to this percentage, clustering and porosity were detected which caused a decrease of the strength of the composite.
- Energy Dispersive Spectroscopy (EDS): Concerning the microstructure characterization, EDS showed the successful incorporation of Graphite and Tin into the matrix while the Carbon peaks scratched out reinforcement integration.

1) Effect of Graphite Content

- Graphite acts as a solid lubricant, enhancing wear resistance and reducing friction. However, excess Graphite (beyond 6%) leads to clustering and a decrease in mechanical properties, highlighting the critical need for optimal reinforcement content.

DOI: https://doi.org/10.52756/ijerr.2025.v48.009

## Declaration of Conflicting Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

## References


Alam, M. A., Ya, H. H., Ahmad, A., Yusuf, M., Azeem, M., & Masood, F. (2022). Influence of aluminum addition on the mechanical properties of brass/Al composites fabricated by stir casting. *Materials Today: Proceedings, 48*, 811–814. https://doi.org/10.1016/j.matpr.2021.02.321

Clinktan, R., Senthil, V., Ramkumar, K. R., Sivasankaran, S., & Al-Mufadi, F. A. (2019). Influence of B4C nanoparticles on mechanical behaviour of Silicon brass nanocomposite through mechanical alloying and hot pressing. *Ceramics International, 45*(15), 18691–18700. https://doi.org/10.1016/j.ceramint.2019.06.094

Deaquino-Lara, R., Soltani, N., Bahrami, A., Gutiérrez-Castañeda, E., García-Sánchez, E., & Hernández-Rodríguez, M. A. L. (2014). Tribological characterization of Al7075-graphite composites fabricated by mechanical alloying and hot extrusion. *Materials and Design, 58*, 9-17. https://doi.org/10.1016/j.matdes.2014.11.045

Dusoe, K. J., Vijayan, S., Bissell, T. R., Chen, J., Morley, J. E., Valencia, L., Dongare, A. M., Aindow, M., & Lee, S.-W. (2017). Strong, ductile, and thermally stable Cu-based metal-intermetallic nanostructured composites. *Scientific Reports, 7*(1). https://doi.org/10.1038/srep40409

Jamwal, A., Seth, P. P., Kumar, D., Agrawal, R., Sadasivuni, K. K., & Gupta, P. (2020). Microstructural, tribological and compression behaviour of Copper matrix reinforced with Graphite-SiC hybrid composites. *Materials Chemistry and Physics, 251*, 123090. https://doi.org/10.1016/j.matchemphys.2020.123090

Jeon, C. S., Jeong, Y. H., Hong, S. T., Hasan, M. T., Tien, H. N., Hur, S. H., & Kwon, Y. J. (2013). Mechanical properties of graphite/aluminum metal matrix composite joints by friction stir spot welding. *Journal of Mechanical Science and Technology, 28*(2), 499-504. https://doi.org/10.1007/s12206-013-1153-0

Kumar, A., Kumar, R., & Kumar, A. (2024). Study of Wear Rate of AA7050-7.5 B4C-T6 Composite and Optimization of Response Parameters using Taguchi Analysis. *International Journal of Experimental Research and Review, 39*(Spl Volume), 73-81. https://doi.org/10.52756/ijerr.2024.v39spl.005

Elkhoshkhany, N., Samir, N., & Yousef, E. S. (2020). Structural, thermal and optical properties of oxy-fluoro borotellurite glasses. *Journal of Materials Research and Technology, 9*(3), 2946–2959. https://doi.org/10.1016/j.jmrt.2020.01.045

Manubolu, V., & Vanimireddy, D. (2023). Experimental Study on Mechanical Behaviour of Arhar-Reinforced Composites using GRA with PCA. *Int. J. Exp. Res. Rev., 36*, 232-243. https://doi.org/10.52756/ijerr.2023.v36.023

Nazeer, F., Ma, Z., Gao, L., Malik, A., Abrar, S., Wang, F., & Li, H. (2021). Effect of graphite mesh sizes on thermo-mechanical properties of Cu-GF composites. *Vacuum, 185*, 109989. https://doi.org/10.1016/j.vacuum.2020.109989

Nithesh, R., Radhika, N., & Shiam Sunder, S. (2017). Mechanical Properties and Adhesive Scuffing Wear Behavior of Stir Cast Cu–Sn–Ni/Si3N4 Composites. *Journal of Tribology, 139*(6). https://doi.org/10.1115/1.4036185

Parikh, V. K., Patel, V., Pandya, D. P., & Andersson, J. (2023). Current status on manufacturing routes to produce metal matrix composites: State-of-the-art. *Heliyon, 9*(2), e13558. https://doi.org/10.1016/j.heliyon.2023.e13558

Kumar Singh, M., Kumar Gautam, R., Prakash, R., & Ji, G. (2018). Mechanical and corrosion behaviors of developed copper-based metal matrix composites. *IOP Conference Series: Materials Science and Engineering, 330*, 012021. https://doi.org/10.1088/1757-899x/330/1/012021

Somavanshi, P. D., & Sathe, Y. U. (2023). Evaluating the electrochemical performance of graphite and silicon-based materials in energy storage device. *REDVET - Revista electrónica de Veterinaria, 24*(4), 474–482. https://doi.org/10.69980/redvet.v24i4.1277

Somavanshi, P. D., & Sathe, Y. U. (2024). Exploring the synthesis processes of graphene oxide and silicon dioxide nanospheres: A comprehensive study. *Journal of the Textile Association, 85*(4), 416–421. https://doi.org/10.5281/zenodo

Somwanshi, P. D., & Rathi, M. G. (2018). To study experimental investigation & wear analysis effects of composite $MoS_2$ on Al 6082 material. *International Research Journal of Engineering and Technology (IRJET), 5*(8), 1523–1526.

Sreenivasa, R., Ramesh, B. T., Giri, J., Al-Sadoon, M. K., Bongale, A. K., Sathish, T., & Banagar, A. R. (2024). Optimizing process parameters to minimize wear-induced material loss in bronze-based hybrid metal matrix composites using the Taguchi method. *AIP Advances, 14*, 095104. https://doi.org/10.1063/5.0203081

Sundararajan, S. M., & Mani, M. (2024). Biodegradable Edible Microbial Cellulose-based Film for Sustainable Packaging from Lab to Land: Physicomechanical Study. *International Journal of Experimental Research and Review, 39*(Spl Volume), 142-153. https://doi.org/10.52756/ijerr.2024.v39spl.011

Yang, Z., Fan D., Zhang T., Shuai Y., Heng M., Miao Q., Wei H., Zhifeng Z., Yanqiang L., & Lidong W. (2023). Effects on the Microstructure Evolution and Properties of Graphene/Copper Composite during Rolling Process. Materials. *Multidisciplinary Digital Publishing Institute*. https://doi.org/10.3390/ma16165534

Yu, T., Zhong, F., Zhang, F., Ying, C., & Geng, G. (2021). Application of Scanning Electron Microscopy in Metal Material Detection. *Journal of Physics: Conference Series, 2002*(1), 012010. https://doi.org/10.1088/1742-6596/2002/1/012010

Jun, Z., Jincheng, X., Wei, H., Long, X., Xiaoyan, D., Sen, W., Peng, T., Xiaoming, M., Jing, Y., Chao, J., & Lei, L. (2009). Wear performance of the lead free tin bronze matrix composite reinforced by short carbon fibers. *Applied Surface Science, 255*(13–14), 6647–6651. https://doi.org/10.1016/j.apsusc.2009.02.063

Zhang, Z., Liu, C. K., Yu, Z. L., & Li, J. Y. (2024). The fabrication of brass reinforced aluminum matrix composites by FSW. *Journal of Materials Research and Technology, 31*, 3383–3392. https://doi.org/10.1016/j.jmrt.2024.07.062

**How to cite this Article:**

Yogesh Sathe and Pawan Somavanshi (2025). Development and Characterization of Brass-Graphite (Sn) Composites for Bush and Bearing Applications. *International Journal of Experimental Research and Review*, *48*, 103-111.

**DOI :** https://doi.org/10.52756/ijerr.2025.v48.009

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.